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EXAMINER	
FITZPATRICK, ATIBA O	

ART UNIT	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/590,887	LEOW ET AL.	
	Examiner	Art Unit	
	ATIBA O. FITZPATRICK	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 July 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *25 August 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date *12/08/2006*.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Priority

Applicant's claim to the priority (effective filing) date of provisional application 60/548836 filed on 3/27/2004 is acknowledged.

Information Disclosure Statement

The information disclosure statement (IDS) submitted on 12/08/2006 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

35 USC 101 – Claim Rejection

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 1-22 are **not** deficient with regards to 35 U.S.C. 101. Independent claim 1 is not drawn to an abstract idea since it pertains to detecting bone fractures. Also, the "meaningful and significant" steps of "image processing a digitized x-ray image" and "adaptive sampling scheme" require a computer to be implemented. It would be unreasonable to expect a human to perform these highly computationally intensive tasks mentally or manually.

Note that although independent claim 21 does not explicitly recite structure, when read in light of the specification, the claim requires and interpretation of structure.

Limitations “means for receiving a digitized x-ray image; and means for processing the digitized x-ray image for detection of bone fractures” invoke the sixth paragraph of 35 USC 112 requiring that the specified means for carrying these actions (as stated in the specification of the instant application) be interpreted as “means” recited in the claim. There is no software only embodiment stated in the specification. The only means offered for carrying out these actions is the computer shown as item 1200 in Fig. 10 and paragraphs 162 and 163 of the specification.

Claim 23 is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter as follows. Claim 23 is drawn to functional descriptive material recorded on a data storage medium. Normally, the claim would be statutory. However, the specification, does not describe “data storage medium”, an does not specifically define a computer-readable medium as only being of a statutory type. Therefore, according to 1351 OG 212, dated 2/23/2010, data storage medium will be reasonably interpreted to cover both non-transitory tangible media and transitory propagating signals per se in view of the ordinary and customary meaning of data storage medium. Note that "data storage medium” can be interpreted as being a transitory medium in that the data contained within this medium is understood to be stored. Furthermore, examiner notes that the cited interpretation is valid even if the specification is silent in regards to computer readable media and other such variations.

“A transitory, propagating signal … is not a “process, machine, manufacture, or composition of matter.” Those four categories define the explicit scope and reach of

subject matter patentable under 35 U.S.C. § 101; thus, such a signal cannot be patentable subject matter." (*In re Petrus A.C.M. Nuijten;* Fed Cir, 2006-1371, 9/20/2007).

Because the full scope of the claim as properly read in light of the disclosure encompasses non-statutory subject matter, the claim as a whole is non-statutory. The examiner suggests amending the claim to *include* the disclosed tangible computer readable media, while at the same time *excluding* the intangible media such as signals, carrier waves. Any amendment to the claim should be commensurate with its corresponding disclosure.

Examiner suggests, as seen within 1351 OG 212 dated 2/23/2010, applicant include the limitation, "non-transitory", within the cited claims to overcome the rejection and to avoid any issues of new matter.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 1-5, 17-20, and 21 are rejected under 35 U.S.C. 102(a) as being anticipated by T.P. Tian, Detection of Femur Fractures in X-Ray Images, as archived July 2003 (Tian).

As per claim 1, Tian teaches a method for detection of bone fractures using image processing of a digitized x-ray image **(Tian: page 2, para 1: "automated fracture detection"; page 2, para 2: "fracture detection"; page 60: "computer algorithm for measuring the neck-shaft angle from x-ray images and using neck-shaft angle to discriminate healthy femurs from fractured femurs"; pages 13-15; Fig. 1.12)**; wherein the image processing comprises an adaptive sampling scheme **(Tian: page 13, para 2: "Femur Contour Extraction"; pages 24-34: Extraction of Femur Contour; Fig. 1.12: "Femur Contour Extraction"; page 37, para 1: "dense sampling of points";Note that in extracting the femur contour, one is sampling the image. That is, the contours are images pixel regions that define the femur present within the image. Note that this method is adaptive since the image data itself is assessed for determining this segmentation. That is, information such as the location or size of the femur is not "hard-coded" into the system. Instead, either one or all of the edge detection, snake algorithm, and gradient vector flow operate based on data provided in the image for determining the segmentation result)**.

As per claim 2, Tian teaches the method as claimed in claim 1, wherein the image processing comprises extracting a contour of the bone in the digitised x-ray image **(Tian: page 24, para 1: "extracting the contour of the femur… modified Canny edge detector" ; pages 24-34; Fig. 3.1)**.

As per claim 3, Tian teaches the method as claimed in claim 2, wherein the extracting of the contour of the bone in the digitised x-ray image comprises applying a Canny edge detector to the digitised x-ray image **(Tian: page 24, para 1: "modified Canny edge detector" ; pages 24-34; Fig. 3.1)**.

As per claim 4, Tian teaches the method as claimed in claims 2, wherein the extracting of the contour of the bone in the digitised x-ray image comprises applying a snake algorithm to the digitised x-ray image **(Tian: page 24, para 1: "modified Canny edge detector… snake algorithm"; pages 24-34; Fig. 3.1)**.

As per claim 5, Tian teaches the method as claimed in claim 4, wherein applying the snake algorithm to the digitised x-ray image comprises creating a Gradient Vector Flow (GVF) **(Tian: page 24, para 1: "modified Canny edge detector… Gradient Vector Flow… snake algorithm"; pages 24-34; Fig. 3.1)**.

As per claim 17, Tian teaches the method as claimed in claim 1, wherein the image processing comprises:

determining a femoral shaft axis in the digitised x-ray image **(Tian: page 35: "midpoints of the level lines are used to determine the orientation of the shaft": Note that this orientation, which is defined by the midpoints, is the axis as is made evident in Fig. 4.1; page 2, para 2: "Given the boundary contour, the orientations of the femoral shaft and the femoral neck are computed"; Fig. 4.1;**

Fig. 4.2);

determining a femoral neck axis in the digitised x-ray image **(Tian: page 43, para 2: "Computing the Axis of Symmetry for the Femoral Head and Neck"; page 2, para 2: "Given the boundary contour, the orientations of the femoral shaft and the femoral neck are computed")**;

measuring an obtuse angle between the femoral neck axis and the femoral shaft axis **(Tian: page 2, para 2: "The angle between these two orientations is the neck-shaft angle"; page 8, para 1: "The neck forms an angle of about 125 degrees with the shaft"; Fig. 1.7)**; and

detecting the bone fracture based on the measured obtuse angle **(Tian: page 2, para 2: "Using the neck-shaft angle as a criterion for discriminating between fractured and healthy femur"; page 46: "Classification using Neck-Shaft Angle")**.

As per claim 18, Tian teaches the method as claimed in claim 17, comprising calculating level lines from respective points on the contour of the bone in the digitised x-ray image and extending normally to the contour to respective other points on the extracted contour **(Tian: page 35: "If normal lines are drawn from one side of the shaft to the opposite side and compute the midpoints of these lines, then the mid-points would be aligned parallel to the shaft (Figure 4.1). We call these normal lines level lines as each line denotes a level along the femoral shaft"; pages 36-38; Fig. 4.1; Fig. 4.2)**.

As per claim 19, Tian teaches the method as claimed in claim 18, wherein determining the femoral shaft axis is based on midpoints of the level lines in a shaft portion of the contour of the bone **(Tian: page 35: "midpoints of the level lines are used to determine the orientation of the shaft": Note that this orientation, which is defined by the midpoints, is the axis as is made evident in Fig. 4.1; page 2, para 2: "Given the boundary contour, the orientations of the femoral shaft and the femoral neck are computed"; Fig. 4.1)**.

As per claim 20, Tian teaches the method as claimed in claims 18, wherein determining the femoral neck axis is based on the level lines in femoral head and neck portion of the contour of the bone **(Tian: page 40, para 2: " cluster long level lines at the femoral head into bundles of closely spaced level lines with similar orientations. The bundle with the largest number of lines is chosen, and the average orientation of the level lines in this bundle is regarded as the initial estimate of the orientation of the femoral neck"; page 40, para 1: "search for the best axis of symmetry using the initial neck orientation estimate")**.

As per claim 21, arguments made in rejecting claim 1 are analogous to arguments for rejecting claim 21. The means recited in the specification of the instant application for receiving and processing a digitised x-ray image is a computer. Tian further teaches this means **(Tian: page 60: "computer algorithm for measuring the neck-shaft angle**

from x-ray images and using neck-shaft angle to discriminate healthy femurs from fractured femurs”).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 6-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over T.P. Tian, Detection of Femur Fractures in X-Ray Images, as archived July 2003 (Tian) as applied to claim 1 above, and further in view of USPGPUBN 20050010106 (Lang).

As per claim 6, Tian teaches the method as claimed in claim 1. Tian does not teach the adaptive sampling scheme comprises identifying a bounding box around an area of interest based on the extracted contour of the bone. Lang teaches the adaptive sampling scheme comprises identifying a bounding box around an area of interest based on the extracted contour of the bone **(Lang: para 307: “locate one or more regions of interest (ROI)… the general position of the femur can be located using a binary image of the hip radiographs thresholded… The relatively thin structure of the femoral shaft can be extracted by applying a morphology operation on the binary image…. outline of the binarized femur superimposed on the original radiograph. The region is cropped”: Note that the crop is a bounding box that is**

based on the outline of the bone; Fig. 16).

Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Lang into Tian since Tian suggests assessing x-ray image data relative to femur fracture including determining the neck-shaft angle of the femur in general and Lang suggests the beneficial use of assessing x-ray image data relative to femur fracture including determining the neck-shaft angle of the femur wherein a bounding box of the femur is adaptively extracted as for “Automated Placement of Region of Interest (ROI)” (Lang: para 307) and “for further processing” (Lang: para 307)in the analogous art of medical image analysis. That is, the adaptive extraction allows for full automation that would be robust to inconsistencies across different image sets. This extraction would then allow for further processing to be performed only one the region of interest. The teachings of Lang can be incorporated into Tian in that the femur region can be extracted after determining the contour and prior to determining the level lines.

As per claim 7, Tian in view of Lang teaches the method as claimed in claim 6. Tian does not teach the bounding box is divided into a predetermined number of sampling points. Lang teaches the bounding box is divided into a predetermined number of sampling points **(Lang: See arguments and citations used in rejecting claim 6 above; para 203; Fig. 16: regular interval sampling points for micro-architecture are shown with +: higher density sampling points for macro-antomical features**

are shown with *: Note that the overlapping square-shaped ROIs contain sampling points and pixel regions between the sampling points).

As per claim 8, Tian in view of Lang teaches the method as claimed in claim 7. Tian does not teach a sampling region around the sampling points is chosen to cover image pixel points between the sampling points. Lang teaches a sampling region around the sampling points is chosen to cover image pixel points between the sampling points **(Lang: See arguments and citations used in rejecting claim 6 above; para 203; para 204: "Window size is preferably set such that it encloses most of the structure being measured"; para 206: "the parameters can be assessed on a pixel-by-pixel basis"; Fig. 16: regular interval sampling points for micro-architecture are shown with +: higher density sampling points for macro-antomical features are shown with *: Note that the overlapping square-shaped ROIs contain sampling points and pixel regions between the sampling points)**.

Claims 9 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over T.P. Tian, Detection of Femur Fractures in X-Ray Images, as archived July 2003 (Tian) as applied to claim 1 above, and further in view of USPGPUBN 20030215119 (Uppaluri).

As per claim 9, Tian teaches the method as claimed in claim 1. Tian does not teach that the image processing comprises calculating one or more texture maps of the digitised x-ray image and detecting a bone fracture based on respective reference texture maps. Uppaluri teaches that the image processing comprises calculating one or more texture maps of the digitised x- ray image and detecting a bone fracture based on respective reference texture maps **(Uppaluri: para 35: "Once the features, such as... texture, etc., are computed, ... a pre-trained classification algorithm 240 can be used to classify the regions of interest 220 into… fractures… normalization of the feature measures from set 280 is performed with respect to feature measures derived from a database of known normal and abnormal cases of interest. This is taken from the prior knowledge from training 250… The training phase 250 may involve, for example, the computation of several candidate features on known samples": When the feature being considered is texture, reference texture features are drawn from the "prior knowledge from training" database and used in the classification; para 34: "multiple feature measures 270 from the… bone images or a combination of those images are extracted, for example… texture": Note that texture features from a combination of multiple images can be determined. Texture features from one of the plurality of images can be considered as a reference being referred to in the classification; Fig. 6: 230-250; Fig. 7: 230, 241, 250; Fig. 9)**.

Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Uppaluri into Tian since Tian suggests analyzing x-ray image data for detecting bone fractures within automatically determined regions of interest in general and Uppaluri suggests the beneficial use of analyzing x-ray image data for detecting bone fractures within automatically determined regions of interest (ROI) wherein texture information is used in the detection in the analogous art of medical image analysis. It would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Uppaluri into Tian since one of ordinary skill would have been well aware that image texture is a highly effective discriminant in medical image analysis applications. The teachings of Uppaluri can be incorporated into Tian in that after Tian detected the femur via contour extraction, texture analysis and classification could be performed on the femur region for bone fracture detection. Note that one of ordinary skill in the art could have combined these elements by known methods in that a computerized system would exist where the ROI determined from the contour extraction performed by Tian would be subsequently processed in texture analysis and classification for fracture detection (as taught in Uppaluri). In this combination, each element would perform the same as it does separately in that the contour extraction portion would perform identical contour extraction actions and the texture analysis portion would perform identical texture analyisis actions on the ROI provided by contour extraction portion. Therefore, the results of the combination would be predictable since the texture analysis actions will

not be changed. The only difference in Uppaluri's method would be that contour extraction would be used for providing the ROI.

As per claim 11, Tian in view of Uppaluri teaches the method as claimed in claim 9. Tian does not teach that the texture maps comprise an Intensity gradient direction map. Uppaluri teaches the texture maps comprise an Intensity gradient direction map **(Uppaluri: See arguments and citations offered in rejecting claim 9 above; para 34: "gradient": para 35: "gradient": Note that the gradient of an image is an intensity gradient direction map. When a gradient is computed for an image, a vector is created at each pixel that shows the direction and magnitude of instantaneous intensity change. This is a measure of texture that is used in Uppaluri for detecting the bone fracture)**.

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over T.P. Tian, Detection of Femur Fractures in X-Ray Images, as archived July 2003 (Tian) in view of USPGPUBN 20030215119 (Uppaluri) as applied to claim 9 above, and further in view of USPN 5776063 (Dittrich).

As per claim 10, Tian in view of Uppaluri teaches the method as claimed in claim 9. Tian in view of Uppaluri does not teach the texture maps comprise a Gabor texture orientation map. Dittrich teaches the texture maps comprise a Gabor texture orientation map **(Dittrich: col 10, lines 52-65: "sequence of selected images is applied to the**

texture pyramid image module 64, which applies, in the preferred embodiment, a set of oriented Gabor or wavelet filter kernels"; col 5, lines 30-35: "two-dimensional image data derived from X-rays"; Fig. 8: 64, 72-78).

Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Dittrich into Tian in view of Uppaluri since Tian in view of Uppaluri suggests performing texture analysis in regions of interest of x-ray images for classifying abnormal tissue regions in general and Dittrich suggests the beneficial use of performing texture analysis in regions of interest of x-ray images for classifying abnormal tissue regions wherein Gabor texture orientation analysis is used in the analogous art of medical image analysis. The teachings of Dittrich can be incorporated into Tian in view of Uppaluri in that the general texture analysis method taught in Uppaluri can comprise Gabor texture orientation filters. Furthermore, one of ordinary skill in the art at the time the invention was made could have combined the elements as claimed by known methods and, in combination, each component functions the same as it does separately. That is, the elements of Tian would continue to return the contour for establishing the ROI. The elements taught by Uppaluri would continue to analyze the texture within the ROI in order to detect fractures. Also, Garbor texture orientation filters would continue to operate the same on the femur ROI image data. One of ordinary skill in the art at the time the invention was made would have recognized that the results of the combination would be predictable. That is, there is no

reason that any other result other than a determination of a fracture being present or not would arise.

Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over T.P. Tian, Detection of Femur Fractures in X-Ray Images, as archived July 2003 (Tian) in view of USPGPUBN 20030215119 (Uppaluri) as applied to claim 9 above, and further in view of USPGPUBN 20050010106 (Lang).

As per claim 12, Tian in view of Uppaluri teaches the method as claimed in claim 9. Tian in view of Uppaluri does not teach the texture maps comprise a Markov Random Field texture map. Lang teaches the texture maps comprise a Markov Random Field texture map **(Lang: para 18: "Markov random field analysis"; paras 188-201: particularly para 195: "Markov random fields can also be used to model the manifestations of the structures in an image in probabilistic term… The nomenclature for the distribution of the characteristic texture"; Fig. 19: "Markov random field analysis… joint feature distributions as they are estimated at each image element or image neighborhood")**.

Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Lang into Tian in view of Uppaluri since Tian in view of Uppaluri suggests assessing x-ray image data relative to femur fracture including determining the neck-shaft angle of the femur and using texture

analysis in general and Lang suggests the beneficial use of assessing x-ray image data relative to femur fracture including determining the neck-shaft angle of the femur and using texture analysis wherein Markov Random Field analysis is used as measure of texture since “Markov random fields can be used to analyze and detect structure density changes” (Lang: para 190) in the analogous art of medical image analysis. The teachings of Lang can be incorporated into Tian in view of Uppaluri in that the general texture analysis method taught in Uppaluri can comprise Markov Random Field analysis.

Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over T.P. Tian, Detection of Femur Fractures in X-Ray Images, as archived July 2003 (Tian) in view of USPGPUBN 20030215119 (Uppaluri) as applied to claim 9 above, and further in view of USPGPUBN 20050111718 (MacMahon).

As per claim 13, Tian in view of Uppaluri teaches the method as claimed in claims 9. Tian in view of Uppaluri does not teach the image processing comprises calculating one or more difference maps between the respective texture maps calculated for the digitised x-ray image and the respective reference texture maps. MacMahon teaches the image processing comprises calculating one or more difference maps between the respective texture maps calculated for the digitised x-ray image and the respective reference texture maps **(MacMahon: para 73: “Geometric features include… texture measures… may be computed in the temporal subtraction image space as well as**

in the space of the two constituent original images… The values of these features are input to a rule-based scheme (or an automated classifier such as linear discriminant analysis or an artificial neural network) to distinguish between regions that represent pathologic change": Note that the image itself comprises measured texture, which makes it a texture map. The texture maps of the original images are differenced in creating the difference image, which is also a texture map. This difference image is classified (relative to its texture measure); para 81: "Dual energy images… bone temporal subtraction"; Fig. 6c: dual-energy x-ray bone image; Fig. 8: s601, s607-s609; Fig. 9: s701a, s701b, s701a2, s701b2, s702, s703, s704b, s705b).

Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of MacMahon into Tian in view of Uppaluri since Tian in view of Uppaluri suggests analyzing dual energy x-ray images comprising automatically selected bone regions of interest in general and MacMahon suggests the beneficial use of analyzing dual energy x-ray images comprising automatically selected bone regions of interest wherein difference texture maps are classified as for "temporal subtraction image interpretation that identifies and indicates the locations of regions representing pathologic change" (MacMahon: para 36) in the analogous art of medical image analysis. The teachings of MacMahon can be incorporated into Tian in view of Uppaluri in that the dual-energy imaging system taught

in Uppaluri can capture sequential anatomical texture maps that can be differenced where the result of this difference can be classified.

As per claim 14, Tian in view of Uppaluri and MacMahon teaches the method as claimed in claim 13. Tian in view of Uppaluri does not teach the difference maps are classified using one or more classifiers. MacMahon teaches the difference maps are classified using one or more classifiers **(MacMahon: para 73: “Geometric features include… texture measures… may be computed in the temporal subtraction image space as well as in the space of the two constituent original images… The values of these features are input to a rule-based scheme (or an automated classifier such as linear discriminant analysis or an artificial neural network) to distinguish between regions that represent pathologic change”: Note that the image itself comprises measured texture, which makes it a texture map. The texture maps of the original images are differenced in creating the difference image, which is also a texture map. This difference image is <u>classified</u> (relative to its texture measure); para 81: “Dual energy images… bone temporal subtraction”; Fig. 6c: dual-energy x-ray bone image; Fig. 8: s601, s607-s609; Fig. 9: s701a, s701b, s701a2, s701b2, s702, s703, s704b, s705b)**.

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over T.P. Tian, Detection of Femur Fractures in X-Ray Images, as archived July 2003 (Tian) in view of USPGPUBN 20030215119 (Uppaluri) and USPGPUBN 20050111718

(MacMahon) as applied to claim 14 above, and further in view of USPGPUBN 20050010106 (Lang).

As per claim 15, Tian in view of Uppaluri and MacMahon teaches the method as claimed in claim 14, wherein the difference maps are classified **(See arguments made above for rejecting claim 14)**. Tian in view of Uppaluri and MacMahon does not teach using Bayesian classifiers. Lang teaches texture maps are classified using Bayesian classifiers **(Lang: para 106: "Bayes Networks); Classification… Bayesian Classification"; para 107: "These methods and processes may be applied to the data obtained using the methods described herein, for example, databases comprising, x-ray image data sets, derived data, and data attributes"; paras 193-194: "Markov random field model… Another analysis approach is through the implementation and training of Bayesian networks"; para 195: "The analysis tools for such a probabilistic framework are provided by the laws of probability and specifically Bayes' Rule shown in FIG. 21. Bayes' rule can be described as the rule according to which our knowledge about the presence of a given characteristic structure in an ROI is updated (a-posteriori information represented by the probability distribution P(T.vertline.ROI))… simply selecting the structure with the maximum a-posteriori information can be used as a decision criterion"; Fig. 21. Note that the Bayesian classification is taught to be applicable to image data and derivations and attributes thereof. Particularly, the classifiers based**

Baye's theorem are used in classifying the Markov Random Field analysis texture measure.).

Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Lang into Tian in view of Uppaluri and MacMahon since Tian in view of Uppaluri and MacMahon suggests assessing x-ray image data relative to femur fracture based on texture analysis including determining the neck-shaft angle of the femur in general and Lang suggests the beneficial use of assessing x-ray image data relative to femur fracture based on texture analysis including determining the neck-shaft angle of the femur wherein Bayesian classifiers are used in classifying the image texture since "The analysis tools for such a probabilistic framework are provided by the laws of probability and specifically Bayes' Rule shown in FIG. 21. Bayes' rule can be described as the rule according to which our knowledge about the presence of a given characteristic structure in an ROI is updated (a-posteriori information represented by the probability distribution P(T.vertline.ROI))… simply selecting the structure with the maximum a-posteriori information can be used as a decision criterion" (Lang: para 195) in the analogous art of medical image analysis. That is, the classification process is simplified. The teachings of Lang can be incorporated into Tian in view of Uppaluri and MacMahon in that the classifier used in classifying the texture (as taught in Uppaluri and MacMahon) can be a Bayesian classifier. Note that the texture of the difference texture image (as taught in MacMahon) can be classified using a Bayesian classifier.

Claim 16 rejected under 35 U.S.C. 103(a) as being unpatentable over T.P. Tian, Detection of Femur Fractures in X-Ray Images, as archived July 2003 (Tian) in view of USPGPUBN 20030215119 (Uppaluri) and USPGPUBN 20050111718 (MacMahon) as applied to claim 14 above, and further in view of USPGPUBN 20030223627 (Yoshida).

As per claim 16, Tian in view of Uppaluri and MacMahon teaches the method as claimed in claims 14, wherein the difference maps are classified **(See arguments made above for rejecting claim 14)**. Tian in view of Uppaluri and MacMahon does not teach using Support Vector Machine classifiers. Yoshida teaches the texture maps are classified using Support Vector Machine classifiers **(Yoshida: para 121: "extended lesion is selected from the set of candidate lesions, based on … texture feature values"; para 17: "FIG. 17 is a flowchart illustrating the steps of detecting a set of candidate lesions based ... texture feature statistics"; para 245: "texture features are computed, the following nine statistics of these features called feature statistics (FSs)"; para 249: "In step 1704, true polyp (or TP polyps) is selected from the set of polyp candidates based on at least one of the FSs such as, but not limited to, the ones mentioned above. For this purpose, FP polyps are identified by classifying of the polyp candidates into TP and FP categories by use of a statistical classifier. This classifier can be a … support vector machine"; para 125: "X-ray"; Fig. 17: 1702-1704)**.

Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Yoshida into Tian in view of Uppaluri and MacMahon since Tian in view of Uppaluri and MacMahon suggests detecting tissue abnormalities in x-ray images by classifying measured image texture in general and Yoshida suggests the beneficial use of detecting tissue abnormalities in x-ray images by classifying measured image texture wherein the a support vector machine classifier is used in the analogous art of medical image analysis. It would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Yoshida into Tian in view of Uppaluri and MacMahon since one of ordinary skill would be well aware that support vector machines have many advantages such as being applicable to non-linear problems, being non-parametric in nature, which makes it ideal for analyzing medical diagnostic data particularly because with medical diganostic (particularly image) data, one can often know the forms of appropriate discriminant functions, but will not know the parameters for these functions. The teachings of Yoshida can be incorporated into Tian in view of Uppaluri and MacMahon in that the classifier used in classifying the texture (as taught in Uppaluri and MacMahon) can be a Support Vector Machine classifier. Note that the texture of the difference texture image (as taught in MacMahon) can be classified using a Support Vector Machine classifier. Furthermore, one of ordinary skill in the art at the time the invention was made could have combined the elements as claimed by known methods and, in combination, each component functions the same as it does separately. That is, merely using a support vector machine to perform the classification does not require any changes to any other

elements. The way that support vector machine classifiers work would not need to be modified in any way. One of ordinary skill in the art at the time the invention was made would have recognized that the results of the combination would be predictable. Using support vector machine for the classification would not cause the result (i.e. bone fracture detection) to be changed in any way.

Claims 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over T.P. Tian, Detection of Femur Fractures in X-Ray Images, as archived July 2003 (Tian) in view of USPGPUBN 20050010106 (Lang).

As per claim 22, arguments made in rejecting claim 1 are analogous to arguments for rejecting claim 22. Tian does not teach a database for receiving and storing a digitised x-ray image. Lang teaches a database for receiving and storing a digitised x-ray image **(Lang: para 85: "a database comprising, for example, reference anatomical maps and the computational unit is further designed to compare the anatomical map with the reference anatomical map. The reference anatomical map may be historic (from the same or another patient"; para 107: "databases comprising, x-ray image data sets")**.

Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Lang into Tian since Tian suggests assessing x-ray image data relative to femur fracture including determining the neck-

shaft angle of the femur in general and Lang suggests the beneficial use of assessing x-ray image data relative to femur fracture including determining the neck-shaft angle of the femur wherein a database is used for receiving and storing a digitised x-ray image in the analogous art of medical image analysis. One of ordinary skill in the art would be well aware of the benefits of using a database since it is relational and one can index into a database to access individual or multiple fields pertaining to a query of interest. A database increases the ease and efficiency of accessing, manipulating, and storing data. The teachings of Lang can be incorporated into Tian in that the image data read into the system for analysis can be stored on a database.

As per claim 23, arguments made in rejecting claim 1 are analogous to arguments for rejecting claim 23. Tian does not teach a data storage medium having stored thereon computer code means for instructing a computer to execute a method. Lang teaches a data storage medium having stored thereon computer code means for instructing a computer to execute a method **(Lang: para 118: "A variety of computer program products can be utilized for conducting the various methods and analyses disclosed herein. In general, the computer program products comprise a computer-readable medium and the code necessary to perform the methods set forth supra. The computer-readable medium on which the program instructions are encoded can be any of a variety of known medium types, including, but not limited to, microprocessors, floppy disks, hard drives, ZIP drives, WORM drives, magnetic tape and optical medium such as CD-ROMs")**.

Thus, it would have been obvious for one of ordinary skill in the art at the time the invention was made to implement the teachings of Lang into Tian since Tian suggests assessing x-ray image data relative to femur fracture including determining the neck-shaft angle of the femur in general and Lang suggests the beneficial use of assessing x-ray image data relative to femur fracture including determining the neck-shaft angle of the femur wherein a data storage medium having stored thereon computer code means for instructing a computer to execute a method is used in the analogous art of medical image analysis. One of ordinary skill in the art would be well aware that implementing a method in software would have the benefit of allowing the system to be easily and efficiently portable, distributable, and maintainable. The teachings of Lang can be incorporated into Tian in that the computerized algorithm taught by Tian can be implemented in software that is stored in data storage medium.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Atiba Fitzpatrick whose telephone number is (571) 270-5255. The examiner can normally be reached on M-F 10:00am-6pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Samir Ahmed can be reached on (571)272-7413. The fax phone number for Atiba Fitzpatrick is (571) 270-6255.

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Atiba Fitzpatrick

/ATIBA O FITZPATRICK/

Examiner, Art Unit 2624